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Zero Retries is an independent newsletter promoting technological innovation that is occurring in Amateur Radio, and Amateur Radio as (literally) a license to experiment with and learn about radio technology. Now in its third year of publication, with 1500+ subscribers.

About Zero Retries

Steve Stroh N8GNJ, Editor

Jack Stroh, Late Night Assistant Editor Emeritus

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Web version of this issue - https://www.zeroretries.org/p/zero-retries-0147

Request To Send

Commentary by Editor Steve Stroh N8GNJ

Paid Subscribers Update

My thanks to **Prefers to Remain Anonymous 26** for becoming a Paid Subscriber to Zero Retries!

Financial support is a real vote of confidence for continuing to publish Zero Retries.

Major Conference Countdowns

- **Hamvention 2024** in Xenia, Ohio, USA on 2024-05-17 thru 19, in *05* weeks!
- **HAM RADIO 2024** in Friedrichshafen, Germany on 2024-06-28 thru 30, in *08* weeks!
- **JARL Ham Fair 2024** in Tokyo, Japan on 2024-08-24 and 25, in *19* weeks!

See other events at the Zero Retries Guide to Zero Retries Interesting Conferences.

A Funny Thing Happened…

Given the large size of **Zero Retries 0146** last week, I wasn't quite sure what would happen when it auto-published at 15:30 Pacific on 2024-04-05. As I was writing it, I received the usual warnings from Substack of "Too large to email", but that's nothing new. But, I was pretty sure that ZR 0146 was the largest single issue of ZR that I had attempted to email. Thus I wasn't sure how Substack (and, potentially, email providers like Gmail, Yahoo, etc.) would deal with such a large emailed newsletter. (I knew the web / online version was available, of course, so I wasn't really too worried.)

A few hours after ZR 0146 auto-published, I was curious and looked at the stats on Substack… *and there were none*. I think it said that there had been one (1) "open". I thought "uh, oh"… My sanity check of having each issue sent to several of my backup email addresses - all of those looked OK. So I checked periodically throughout the evening, several folks "liked" ZR 0146, but the weird stats didn't change.

On Saturday morning I got a status message from Substack saying that the publisher dashboard function wasn't working… **Oh… OK, whew!** Sure enough a few hours later Substack fixed the dashboard, and the usual stats showed up, indicating that yep, folks were opening ZR 0146, clicking on links, etc.

The one time I really cared about seeing the stats…

Well, it ended up being funny to *me*, at least.

And Another Funny Thing…

On Tuesday this week I received an odd voice mail (the caller wasn't in my Contacts, thus didn't ring through) informing me that www.zeroretries.org was going to a "This Domain Parked" page. My first thought as I was listening to the voice mail was that it was another "register your domain with *us*" scam, but then the caller finished with their name and callsign and mention that we had met briefly. Sure enough, www.zeroretries.org *was* offline and the domain registrar was redirecting it to a "parked" page. Oh, *crap*… But updating the credit card on file for that domain (one of the many expenses helped by paid subscriptions) got things back to normal. For some reason the domain registrar had not notified me that the zeroretries.org domain auto-renew had failed for an out-of-date credit card.

Thank you Jack Wolfe KI7RMU for the heads-up about www.zeroretries.org.

Rescanning TAPR Packet Status Register

A number of the scans of various issues of the TAPR Packet Status Register (PSR) newsletter on the TAPR website and Internet Archive's Digital Library of Amateur Radio & Communications (DLARC) are of poor quality, and thus the Optical Character Recognition (OCR) conversion of printed text to electronic text *suffers*. (The PSR article cited in the second article in this issue is an example - the resulting text required a fair amount of manual cleanup. Example: deter¬ mines.

I don't remember which issue of PSR it was that I wanted to do a cut and paste from, and noted the poor quality of the OCR'd text. That coincided with having declared a block of a few days as "decrapify my office for better productivity" and one background task I had been deferring was scanning my archive of PSRs, so I decided to *just **do** that* as I was sitting and decrapifying my office. I set my scanner (a venerable, but working great Fujitsu ScanSnap S1500M sheet feeder) to minimal compression, highest resolution, gray scale, and simultaneous OCR, and I was surprised how little time was required for each scan. The ScanSnap application seems to make good use of multiple cores on my Intel Mac Mini and my office decrapifying workflow was chopped up into five minute blocks as each issue scanned and OCR'ed. (I converted all of my paper PSR copies into single sheets for sheet feed scanning.) PSR is the "publication of record" for much of the evolution of Amateur Radio Packet

Radio, so it made sense to me that PSR justified one final high resolution scan, and I had a lot of the earliest issues that I think were given to me upon my becoming (briefly) the editor of PSR, so it could be that I'm one of the last to have these good issues.

Thus I stumbled on the WA7GXD / KK7P article on bit-regenerative repeaters, and that article was highly relevant to this issue's theme.

Confluence of Packet Radio Networking Ideas

Sometimes, things just come together for Zero Retries (but admittedly, I cast a wide net for Zero Retries Interesting items). In this case, the three primary articles all came out or were rediscovered within the same few weeks, and all of them nicely fit together into the theme of Amateur Radio data networking:

- Don Rotolo N2IRZ's thoughts about the guiding philosophies of Terrestrial Amateur Packet Radio Network (TARPN)
- Lyle Johnson WA7GXD / KK7P on improving the efficiency of Amateur Radio data communications over Amateur Radio repeaters
- Brian Webster N2KGC's thoughts on modernizing existing Amateur Radio (Packet Radio) data networks for a new generation.

Not exactly a grand plan… but it works together.

Honoring Confidentiality… However Frustrating That Is

I've been in touch this week with two developers with exciting projects… that I can't talk about here in Zero Retries - yet.

One group of developers just received an ARDC grant which makes their project viable. Their project is foundational to Amateur Radio, similar (I think) in scope to the difference that Internet Archive's Digital Library of Amateur Radio & Communications (DLARC) is making to Amateur Radio in preserving its history to inform the present (such as the third article in this issue). That grant hasn't been made public yet by ARDC, so the developers don't yet feel free to reveal their (now grant funded) project. But I'm working on the story to be ready for when ARDC does disclose their "Spring 2024" grants.

Another exciting project has been in development, but was stalled until recently, and the news I got about its renewed progress is really exciting. But those developers would prefer not to discuss their recent progress pending a big reveal at a future event… and I totally get that as that's the way I feel for some issues of Zero Retries when I feel I have a particularly good story to tell.

I *wish* I could "tell all", folks, *as soon as I learn* about exciting stuff. But, keeping exciting news confidential, as background information, until the *newsmaker is ready to announce* is the price to be paid. The upside of knowing a bit more about exciting developments *that are in progress* makes Zero Retries better, if for no other reason than I have a very real, substantive basis for the positive, progressive, hopeful tone about technological innovation in Amateur Radio that I try to maintain here in Zero Retries.

In the Meantime at N8GNJ Labs…

The biggest accomplishment / time sink of the week was a household infrastructure project to pull an Ethernet cable between the house and N8GNJ Labs. The Starlink terminal that's our primary Internet access is next to N8GNJ Labs and has been performing perfectly. I have *no* complaints *at all* about Internet Access via Starlink and even with the current slightly compromised location, it just *works*. A recent Starlink speed test was 173 Mbps Download, 10 Mbps Upload, ~20 mS latency - works great for video streaming and the occasional upload, and video conferences. But, I didn't have good connectivity *between* the house and N8GNJ Labs.

I had been relying on a pair of "power line modems" to connect N8GNJ Labs and the house, but they have been gradually degrading, and in the last few weeks they've required multiple "unplug, wait 10 seconds, replug" cycles per day. That unreliability was finally to the point that this week I opened up a wall in N8GNJ Labs where I ~~knew~~ *was pretty sure* there was a conduit between the house (somewhere) and N8GNJ Labs. To my delight (and relief), the conduit *was* where I ~~thought~~ *hoped* it was, and it was a *2-inch conduit* with only one legacy telephone cable in it.

It took me all day, much disruption in N8GNJ Labs (not all put back to normal as I write this), and several trips to Hardware Sales (we're blessed to have a *real*, independent hardware store here in Bellingham) for "supplies". There is now "just plain Ethernet" between N8GNJ labs and the house running at "wire speed" - and "what a relief it *is*" to finally have "no hiccups" connectivity between N8GNJ Labs and the house. Sometime this summer when I've had time to study and plan and purchase all the required units, that Ethernet will be replaced with fiber (mostly for electrical isolation) and I'll finish the household / N8GNJ

Labs network integration. For now, Ethernet works *perfectly*. For household Wi-Fi, I continue to recommend the Ubiquiti UniFi Express. (No compensation, just a hands-on recommendation.) Despite its diminutive size, its performance is stellar.

It looks like I'll be picking up a Direct Broadcast Satellite (DBS) dish this weekend, complete with Low Noise Amplifier and the receiver, courtesy of the Free Stuff section of Bellingham Craigslist. This will be my third such free dish (but my first receiver). I don't yet have an intended purpose for them, but free is… well, *free*. Perhaps I'll eventually have enough to start *my* Very Small Array.

Stuff I read / listened to / viewed in the past week included:

- Ham Radio Workbench podcast 205 - Universal Radio Controller with Mark Herbert G1LRO. Those folks just *project* that they're having a good time playing with Amateur Radio, and it feels infectious / reinforces that I want to be playing along on *my* workbench / workshop.
- I watched the Tech Minds (Matt Miller M0DQW) review of the KiwiSDR 2 on YouTube. M0DQW does a *great* job of reviewing Zero Retries Interesting units without the breathless and overhyped style (he doesn't even appear on camera) of many other Amateur Radio YouTube creators. The KiwiSDR 2 is a sweet piece of kit and the review convinced me that the KiwiSDR 2 is now next up on my sliding "About $200 discretionary budget" for Amateur Radio projects. Now I just need to wait for the ordering window for Batch 3 of the KiwiSDR 2 to be opened. I'm on the list to be notified.
- The Mount Baker Amateur Radio Club's (MBARC) 2024-04 General Meeting was a presentation by AMSAT Ambassador Clint Bradford K6LCS on **How to Work Amateur Satellites with Your Handheld Radio**. (The video recording is pending as this issue is published, I'll update this when the video is available.) K6LCS tailored his presentation (as he always does) for MBARC, with some amusing elements. After K6LCS' presentation, I (and I think many of us) felt like "Wow… *why am I **not** working these "Easy Sats?*". At a minimum, I'll soon be dedicating a radio and receive antenna to monitor for the International Space Station's audio (and packet) downlinks, as well as other Amateur Radio satellites that have FM downlinks. (Doing so beats scanning local repeaters that are almost entirely quiet except for automatic identification.) You can learn more about K6LCS and his presentations and Amateur Radio satellite evangelism at his www.work-sat.com website, or contact him by phone at 909-999-SATS (7287) or email - clintbradford@mac.com.

The biggest adventure of our household for the coming weekend is that the grandkittens are coming to visit… sans parents… and oh, I don't think our household is anywhere near ready for two energetic kittens. We shall see - it will *certainly* be an adventure for these two "city kittens" who have only lived in the confines of a two-bedroom apartment.

Have a great weekend folks!

73,

Steve N8GNJ

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What's New at Digital Library of Amateur Radio & Communications

By Kay Savetz K6KJN
Zero Retries Pseudostaffer

Happy spring from the Digital Library of Amateur Radio & Communications. If you're just tuning in: I'm Kay, the person who is lucky enough to oversee the creation of this unparalleled online library of ham radio and related communications. Here are some the latest additions to the DLARC library.

The Manuals Plus collection scanning project is in the home stretch: the scanning center is working on the fourth and final (well, for now) pallet of radio-related manuals that were rescued from a warehouse in 2015. Last month I noted that the collection had 2,450 manuals — today, there are 3,771 manuals from that collection scanned and online. I've found everything from a skinny 20-page manual for the Weston Model 1092 Sensitrol relay to a nearly-1000 page behemoth operation manual for the IFR COM-120B Communications Service Monitor.

Also new in DLARC are two issues of SSTV Today, a newsletter devoted to slow scan television. I learned about SSTV Today through the obituary of its publisher, Ron Flynn KB8LU. Mr. Flynn passed away at the age of 82 on February 22. Among many other accomplishments and interests that were part of a life well-lived, the obit mentioned his newsletter. I wrote a letter to his family. His window Patricia wrote back a lovely letter: "Because my husband was legally blind, I was quite involved with his computer work, and accompanied him several times to the Dayton, OH amateur radio convention. I have found two copies of SSTV Today, and will gladly give them to you for the archives." The two issues that she sent were v1n4 from November 1983,

and v2n7 from July 1984. You'll find dot-matrix printouts, a report from Dayton Hamvention, and ads for SSTV gadgets (some of which seem astoundingly expensive when price adjusted for inflation!) Of course I'm dying to find other issues of SSTV Today to add the the DLARC library. I've added them to the ever-changing DLARC Wantlist.

I learned about Cornbread Road — Jeff Davis KE9V's audio-format ham radio mystery — here in the pages of Zero Retries. Davis released the episodes in 2010, but it was difficult to find them online recently. KE9V agreed to re-release Cornbread Road — all 13 episodes plus the hard-to-find epilogue — on DLARC. His intriguing blurb for the series: "Deep in the Heartland a small group of ham radio enthusiasts enjoy an idyllic existence of wide open spaces, no antenna restrictions, low-noise levels, simple living, and good fellowship. But things aren't exactly as they seem. Unexplained lights in the night sky, radio signals masked from the ether, strange late night visitors to this small farming community…"

How's your Portuguese? I ask because DLARC just added 46 issues of Revista QSO, a free monthly publication published in Brazil. The magazine is aimed at radio amateurs, and also covers related subjects such as electronics, robotics, programming, drones, and 3D printing. The "zeroth" issue was published in 2011, but the magazine hit its stride with a more regular publishing schedule in 2020.

How's your Polish? My Internet Archive colleague Jason Scott has been archiving all sorts of public domain works in the Polish language: that collection is closing in on a half-million items. A small subset of that material is about radio, so I pulled those into a Radio Books in Polish collection: 164 items so far, including many issues of "Krótkofalowiec Polski" — that's Shortwave Polski, a monthly magazine devoted to Polish amateur radio — and "Radiotechnik," an "illustrated monthly popular-technical magazine devoted to radio engineering and related fields." Most of this material spans the years 1928 through 1939.

Switching back to the English language, we've added 125 newsletters from the North East Weak Signal Group N.E.W.S. Letter. Based in Longmeadow, Massachusetts, NEWSG is a flock of VHF/UHF/SHF enthusiasts. We have their newsletter going back to 1996. I've also added 20 recent issues of the National Radio Club DX News newsletter, bringing the number of issues in that collection to 2,763, going back to the group's founding in 1933. National Radio Club is the oldest and largest club dedicated to medium wave DX.

Speaking of old clubs, the Fort Wayne Radio Club has been around for more than 100 years. Bob Streeter W8ST just uploaded more than 50 issues of that group's newsletter, Allen County Ham News.

The WA7BNM Contest Calendar provides detailed information about amateur radio contests around the world, including their scheduled dates/times, rules summaries, log submission information and links to the official rules. Bruce Horn WA7BNM has been providing this service for the amateur community since 1998(!) He serves up this contest information in a variety of formats, including a weekly newsletter. At my request, Bruce dug through the database and managed scrape up the newsletters going back to 2002. Thanks to his meticulous research and keeping old data, DLARC now has a searchable record of ham radio contests — 1147 weekly newsletters, going back 22 years.

We've added a collection of vintage documents from Eastnet Packet, a packet radio group that's been around for decades: look here for Flexnet and IGATE manuals and other good stuff.

Believe it or not, this isn't even close to a complete list of everything we've added to DLARC since I wrote last month. For instance, there's a nearly constant influx of recent amateur radio newsletters from around the world. The scanning centers in Fort Wayne and Boston are always ingesting new material. There are partially-finished projects in the works that I will tell you about later this year. I encourage you to go to the DLARC homepage to search or browse for your favorite radio topic. If you don't know where to start, follow the advice of N3VEM who said on Mastodon, "So here's a fun thing to do — go to @dlarc section of the Internet Archive and do a search on your own callsign, and see what pops up." (Tip: choose the "Search text contents" button for the deepest search.)

Digital Library of Amateur Radio & Communications is funded by a grant from Amateur Radio Digital Communications (ARDC) to create a free digital library for the radio community, researchers, educators, and students. If have questions about the project or material to contribute, contact me at kay@archive.org.

Kay Savetz K6KJN is the Internet Archive's Program Manager, Special Collections… the curator of the Digital Library of Amateur Radio & Communications project.

TARPN Terrestrial Amateur Radio Packet Network

Image courtesy of TARPN

Why TARPN?

By Don Rotolo N2IRZ
Zero Retries Contributing Author

You may have heard of the Terrestrial Amateur Packet Radio Network (TARPN), and indeed you may even be running a node in one. If so, you can skip to the end, but for the rest I encourage you to read on for a snippet of a Zero Retries Interesting (ZRI) thing.

AX.25 packet isn't new, nor is G8BPQ networking1. Many of us experimented with packet way back when, and ultimately found it uncompetitive with what could be done with the then-nascent Internet. Or more recently been involved with APRS, one popular application for packet. But other than a few mild tricks, the modern world doesn't need packet, much like it doesn't need AM on HF – there will always be enthusiasts, but it's not mainstream. Or?

A large-ish group in the Raleigh area has built a fairly large, well-performing packet network of around 50 nodes over several counties in North Carolina. Other areas, including Virginia and Kentucky, are growing their own AX.25 TARPN networks. So, why the interest in 1980's technology? I mean, are they really satisfied with 1200 baud links over a dozen or more hops?

The short answer is that AX.25 is a means to an end. Several ends, in fact. The biggest end is the social network it forms: An application called TARPN Home (by Fin Gold NC4FG) includes a really spiffy real-time Chat feature, keeping those on the network in contact with each other. Even with what we might consider slow links, this app is surprisingly fast and more than responsive enough for serious real-time conversations. And you don't need to tie yourself to your station: Using WiFi for the last few yards, its HTML user interface lets you use it on any device that supports a browser.

So way back when, in the heyday of packet networks, most networks had trouble traversing a dozen links. This was neither a failure of AX.25, nor of the packet networking software being used, but one of network design in the RF space. There were two major errors prevalent: Shared frequency links and user ports.

Shared frequencies for network links seemed to be a good idea, saving money on equipment and allowing better coverage when someone was lucky or persistent enough to score a high-visibility antenna site. But the issue here is that collisions, hidden-transmitter syndrome (HTS) and channel saturation cliffs doomed these shared channels to failing as soon as they got even a little busy. The simple solution? Dedicated point-to-point links for every link. This is one of the hard and fast rules of a TARPN.

User ports on a shared access frequency also seemed like a good idea, allowing users easy access to the network with modest equipment. But in addition to again suffering from HTS and that saturation cliff (where the channel capacity drops suddenly to zero), it had the even more deleterious effect of separating networkers into two classes: Sysops and Users.

Users had no skin in the game, and so would either go do other things when the channel didn't work as desired or engage in (often unwitting) destructive behaviors like highly-aggressive TNC parameters, hurting the channel for everyone. Sysops generally enjoyed great network access, but soon tired of complaints from users, dampening their enthusiasm for spending what were considerable sums at the time for a bunch of whiners. The simple solution? No user ports, everyone is a sysop. This is another hard and fast rule of a TARPN: To participate, you need to build a node and link in.

Some of the other rules are to allow for reasonable support possibilities: Only G8BPQ nodes, running a TARPN profile, on Raspberry Pi computers, where everything is discoverable and transparent. Big-money and high-visibility sites* aren't mixed in, keeping it controllable by the individuals. And, non-Amateur Radio sources for data carried by the network are limited to cut & paste. Internet links and other wormhole-like paths are forbidden, as these only serve to make people lazy, in addition to not promoting amateur radio.

While the rules for a TARPN might seem restrictive, they make a huge difference in how the network functions. TARPN links do not have a tendency to fail when traffic reaches saturation. HTS and collisions are nearly nonexistent. And when there is a link failure, diagnosis is straightforward.

While the social network created by the chat feature of TARPN Home is arguably the killer app, that isn't the only reason to build a TARPN. Learning is one of the top other reasons: Antennas, propagation, Linux, networking, station-building, wiring, soldering, and a bunch of other really valuable skills are practiced and perfected. And new friendships bloom, which is a different but still valuable kind of social network.

And what's the ultimate goal? Growing amateur radio. Us old folks will eventually die off, and with no younger blood to carry on, we're doomed. Ham radio will not go away so easily, but as the ranks thin, it becomes less relevant, a kind of death spiral. Kids are rarely interested in nets, repeaters or traffic handling, but give them an app on their phone so they can chat with their friends and they'll consider getting their license. To that end, we all need to run regular events at club meetings, teaching how to solder and build things, getting on HF to have conversations with distant places, talking through (or to!) satellites, and other high-energy fun. Beginners night, every month.

Is that all there is? No, not by a long shot. But writing more about it is wasteful when there's a website, https://tarpn.net, that covers all the details in great depth. Go take a look at the Shopping List for Node Construction (on the builders page) to see if you have enough to build two nodes. Then follow the lengthy-but-simple instructions to build and configure them. If you need

help, there's a Groups.io mailing list dedicated to TARPN where help is plentiful. Even without radios, you can get them talking over wires, and start to explore the possibilities for under $100. Try it, I think you might be surprised. But I need to warn you: The fun doesn't really start until you have around 5 nodes.

* High visibility sites - i.e., not at someone's home, as in a commercial tower, where 24/7 access may be challenging. If someone lives atop a big hill, that's fine. Access is the concern, particularly when the system is being stressed.

Don Rotolo N2IRZ is a writer on Zero Retries Interesting topics, most recently with his decades-long bimonthly column Digital Connection in CQ Amateur Radio Magazine.

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Advantages of a Bit-Regenerating Repeater for Local Area Networks

By Lyle Johnson WA7GXD / KK7P

Prelude by Steve Stroh N8GNJ

This article is from the TAPR Packet Status Register newsletter #46, dated 1992-04, page 7 and 8. This might seem a counterpoint to N2IRZ's article - it's not. But it is convenient timing that N2IRZ submitted his article for the same issue that I had planned to run this article, thus offering a perspective of two different approaches to build Amateur Radio data networks. As you read in N2IRZ's article, there are working TARPN networks - present day, so provably, TARPN's approach works. The "TARPN philosophy" precludes use of repeaters (see mentions of "Sysops" vs "Users" in N2IRZ's article) despite that such repeaters eliminate Hidden Transmitter Syndrome and make it very easy to "get on the network".

This article is the first mention of Bit-Regeneration Repeaters for Amateur Radio Packet Radio that I'm aware of. This article was the impetus for the creation of the Puget Sound Amateur Radio TCP/IP Group's network which, at its peak, provided five bit regeneration repeaters for general access. Four of those were 9600 bps based on the TAPR bit-regeneration option board for TAPR 9600 bps modems running on TAPR TNC-2 TNCs (and clones). I can testify from direct experience that the theoretical advantages that WA7GXD / KK7P explains in this article were borne out in practice on the 9600 bps bit-regeneration repeaters we built and used in the PSARTG network.

And yes, I concede the point that despite its technical sophistication, the PSARTG network no longer exists, and TAPRN networks exist and are growing.

While the specific technology described in this article is now outdated, I think that the idea of data via repeater is useful addition to Amateur Radio capabilities. There are several "game changers" that may well make data via repeater more viable in this era, including…

- *Much better modems, such as the vastly improved sensitivity and "recoverability" in the Dire Wolf software TNC. And, modems and protocols based in software mean that systems can now evolve and improve for both infrastructure and users.*
- *Implementation of Forward Error Correction (FEC) such as Improved Layer 2 Protocol (IL2P) that vastly improves the throughput of data without requiring retransmission.*
- *We have the potential for even faster data rates than 9600 bps now and that could easily minimize the "no one goes there anymore… it's too crowded" effect of a popular resource like a data repeater.*
- *Some Amateur Radio data communications systems are now making use of Orthogonal Frequency Division Multiplexing (OFDM) in the audio channel; essentially subdividing the audio spectrum into many discrete "subchannels" and then dynamically managing each subchannel. This requires significant compute power, which is no longer expensive.*

While I think the ideal method of doing so would be to install a Multi Mode Digital Voice Modem (MMDVM) which would include the still-in-development MMDVM-TNC data mode, but there are other methods for data via repeater such as using VARA-FM over an analog FM repeater, with the repeater programmed to transmit a different subaudible (Continuous Tone Coded Squelch System - CTCSS) tone when VARA-FM is being used, and thus voice users can choose to mute the repeater unless voice is being transmitted.

I predict that we will start seeing a slow evolution of analog FM (voice) repeaters that, while still online, are now mostly silent, being "repurposed" into transporting data as well as analog FM voice. It might end up being a faster evolution if MMDVM-TNC is released as a working system.

Background

Over the past ten or twelve years, a number of approaches have been taken to the design of packet radio-based local area networks (LANs). These designs have used various protocols (polling, balanced “interrupt-driven” systems like AX.25, connection- oriented and datagram styles) as well as varying approaches to “medium access.” Typical implementations include systems with full-duplex audio repeaters, digipeaters, single-frequency “networks” and various ad-hoc combinations of all of the above.

In this paper I will attempt to outline a cost-effective, spectrum-efficient method of network implementation at the local level.

Media Access

Media access is a term used to describe the method by which a packet radio station determines that it may safely transmit data, and how it determines if the data it sent was successfully received by the intended recipient.

Most packet radio modems in common use provide a data carrier detect (DCD) output. This signal is used by TNC software to determine if the modem’s bits are worth decoding (valid signal) as well as to determine if the channel is occupied by another station, in which case the TNC will defer its transmission.

There are fundamental problems with this general approach. In some cases, a station may be able to hear distant stations (a hilltop location, for example) and the DCD will cause this transmitter to defer forever, even though its transmissions might not cause any problem to the distant station’s operation (which may be communications with a nearby station at the distant location, for example).

Or, the station’s DCD circuit may be implemented poorly, allowing transmissions to occur and generate interference with stations it was unable to reliably detect.

There is one school of thought which suggests that, since DCD is an often unreliable indicator, it should be ignored and other approaches used to arbitrate channel access. There are others who would couple this approach with a system allowing the TNC to control the transmitter power output level to create "cells” much like a cellular phone system. This approach is valid and is being pursued.

However, there is another approach that is not widely used, but overcomes much, if not all of the problems associated with geographic considerations.

Full Duplex Repeater-based LAN

The use of a full-duplex repeater brings a significant advantage to local area network communications.

It virtually eliminates the “hidden station” effect. If the repeater can hear a transmission, then every station that uses the repeater can hear the station. Thus, DCD can be used as a reliable indicator of channel occupation.

The geographic coverage of the LAN can then be tailored by repeater location and antenna configuration (use of downtilt, broad lobe beam antennas, etc.). Repeater-based LANs can then be networked using another frequency, or combination of frequencies, to implement an efficient network topology.

The usual objection to the use of repeaters is that they require duplexers, and duplexers are several hundred dollars, so repeaters shouldn’t be used. However, in many cases single-frequency “digipeaters” are co-located in intense RF areas and require the use of RF filters as well. And, “node stacks” typically combine several RF transmitters and receivers in close proximity, also requiring RF cavities and/or duplexers.

The use of a full-duplex repeater can be significantly enhanced with the addition of a bit regenerator.

What Is A Bit Regenerator?

In its simplest form, a bit regenerator is a device which is interposed between the repeater’s receiver output and transmitter input. It incorporates a modem (demodulator portion) to recover the received data to the bit level (digital levels, not analog or audio). These bits are then used to drive a modem (modulator portion) which then drives the repeater’s transmitter. DCD is typically used to provide the PTT mechanism to the repeater. The advantage of this is that the transmitted signal is of the proper deviation, even if the received signal is seriously under- or over-deviated.

Another advantage is that the repeater is dedicated to the function for which it has been coordinated -packet radio (or RTTY or whatever other digital mode is designated for it). There are several drawbacks to this simple approach. Perhaps the most serious drawback is related to clock recovery. Any “jitter” on the received data due to noise will be retransmitted. If the received signal is marginal, the transmitted signal will automatically be at least as marginal. Thus, if you have a less than optimum path to the repeater, you will have a difficult time decoding signals from other marginal users. The bit-regenerator can be enhanced to overcome this primary difficulty. A first-in first-out (FIFO) buffer can be incorporated to collect some number of received bits, then deliver them to the transmitter. This buffer acts somewhat like a rubber band, stretching and shrinking as needed to keep the transmitter happy. In this manner, clock jitter is completely removed by use of a crystal-controlled clock on the transmit modem.

The buffer must be deep enough to allow for variations in the speeds between various modems (usually well under 0.1%). For Amateur packet radio needs using AX.25 protocols, or any other protocol where the number of bits in a given transmission is under about 20,000, a 16-bit deep FIFO filled to 8-bits before transmission occurs, will easily suffice.

Other Potential Advantages

The implementation of a bit-regenerator on the TAPR 9600 bps modem has other advantages that may be exploited by future TNC firmware. If the bit regenerator/modem is attached to a TNC, the TNC PTT will override the FIFO buffer output. This would allow, for example, a nodestack using a full-duplex bit-regenerator repeater to "grab the channel" in case of an emergency or for administrative purposes. At the same time that the TNC is sending its data, it will still be receiving the uncorrupted transmission from the station which was being regenerated. Thus, the received data is not lost and may simply be delayed if the proper firmware is available for the TNC.

Another application, also requiring specialized firmware, is that of channel-use enforcement. Enforcement is a strong word to use in the Amateur context, but consider the following scenario. Assume a bit-regenerating repeater is being used for a local area network, and that specialized firmware exists on the attached TNC. Further assume that a local user comes on frequently during "prime time" and refuses to set his TNC's parameters to share the channel in accordance with locally agreed upon guidelines. Maybe this user likes to transfer megabyte files and sets DWAIT to 0, persistence to 255 and FRACK to 1. He is a hog. After repeatedly asking him to change his patterns, the system administrator simply logs this station's callsign into the "lock out" list on the TNC. Now, whenever this callsign is detected by the TNC, the TNC simply asserts its PTT for 10 mSec and the repeated transmission is corrupted. Thus, the channel abuser is prevented from using the machine. When he amends his ways, his call is removed from the TNC's blacklist and he can share the channel resource with everyone on an equal basis.

To implement this, the TNC would simply check for the "FROM" call field in the packet as its is being received. There is no need to wait for the CRC! If the incoming packet is decodable by anyone, the address header will be received correctly. If it is correct, then the PTT assertion can occur prior to the CRC to ensure the packet is "locked out". If the header is misinterpreted due to noisy reception, then the bit-regenerated packet will be exactly as corrupted, and the packet would be rejected by all listening stations anyway. Thus, the enforcer mode is technically feasible. Or, assume that a METCON unit is attached and it is monitoring the deviation of incoming stations via the detector output from the repeater. A transmission could be sent to a station running with too much deviation, asking him to reduce his deviation. Or an automated deviation reporter could be implemented, providing a community resource for getting the deviation set properly. Finally, a bit-regenerator makes a full-duplex 9600-bps (or faster) local area network not only feasible, but easily doable. Hopefully, the availability of the TAPR 9600 bps modem with its bit-regenerator capability will encourage the growth of such higher speed LANs.

Conclusion

A bit-regenerating full-duplex repeater offers many advantages when implementing a local area network. It allows existing TNCs and radios to work in a coordinated fashion, defines a geographic area of coverage and removes hidden stations within that area of coverage. It offers opportunities to encourage technically and socially sound usage patterns for the shared spectrum resource.

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Why It's So Hard to Get People Excited About Using Connected Packet Systems

By Brian Webster N2KGC

Editor's Note - This article was posted to the EastNetPacket mailing list. Much of the discussion is specific to the collection of technologies and networks that make up EastNet (in the New England region in the Northeast US), but Brian's observations about the general issues of current packet radio networks are, in my opinion, "spot on". This article complements the previous two articles well as another perspective on Amateur Radio data networks.

It has occurred to me, that one of the big reasons modern hams are not getting excited about packet radio, is the fact that it's hard to try and understand what the network even does.

Let's face it, if you did not do packet back in the 90's you don't have any appreciation for what the network is really doing. Most new hams have never had to use a dial up modem and log in to their ISP with a terminal program.

While our networks are not blazing fast fiber internet speeds, they will do a lot of cool stuff still at the speeds we can offer.

A major drawback for everyone is the fact that they have no idea what to do on the network, everything is command line basic text driven. Failing to recognize this drawback is what is keeping anyone new from coming in to the fold.

What I am struggling with is having a user interface that today's users can function with is the modern day skill sets users have. If

you are to try to play around on any packet network these days, you have to have a knowledge of the old command line abbreviated text commands, that is exacerbated by the various node operating systems and their own unique commands and features. You really have to hack around even when you know how current pack systems work. Here is something of what I am frustrated with. Connecting to a large packet network now these are the various Node operating systems you are likely to encounter:

- [G8BPQ]
- JNOS
- FlexNet
- X-Net
- XR-Node
- URONode
- Variations of native Linux nodes
- Kantronics KA-Node
- And others….

There was never any standardization and NONE of those archaic functions have been ported to something useable in today's world. If you manually try to crawl around a packet network node hoping to explore, you likely have to know what commands and command line features are available once you connect. Most hams these days have no idea what even one of these operating systems can do or even how to get a basic help file or a simple description of what they just connected to.

The BBS system are just as problematic; the funny thing is that most of them can operate very much like today's web based forums do. The Outpost Packet Message Manager software is a step in the right direction in addressing this.

What is needed is a local hardware/software device like the DigiPi that gives you a basic web page, with wireless connectivity that you can use a phone, tablet or other computing device to connect with. This appliance should detect what node operating system it just connected to and locally offer from the device memory, a web page(s) that provides some hints in HTML format of what commands can be used and the things you can do on the network. If the OS is not known, it serves up some help on how to figure it out or some basic commands that can be tried. All of this help should be HTML formatted on the local device so that it reads easily, but on slow speed networks all of that information does not need to transit the network. Until something like this happens, packet will stagnate.

How many of you know how to connect and use a BBS? Did you know that many nodes and BBS also have the ability to connect to local and worldwide chat systems? Did you know that there are still DX Clusters operating on packet? Would you know how to interface with the WinLink System by packet or did you even know that you can?

Now imagine that you know nothing about packet and are trying to figure out how to use it.

What we need is an effort to really simplify the USER experience on a packet network. They need to believe that there are so many functions that we can do on these networks we have been building and maintaining all these years and that it can be done without the Internet in so many cases. A lot of the new hams got interested in the hobby because they wanted to do cool things like that. But we have failed them with packet because we have not advanced the user interface that was designed in the late 70's and early 80's

This is where we have failed. Steve Stroh has talked about this problem in Zero Retries with his idea of the perfect all in one appliance. That device is getting closer to reality with the DigiPi and now you can get the radio interface with GPS that requires no soldering, so we are getting closer. But even if Steve declares that someone has the perfect device, when they use that and try to interface to the packets networks, there is still going to be a great deal of disappointment with packet radio.

It's not that we don't have the technologies available. The developers have been doing a great job adapting and improving over the years, what we have missed the boat on is the end user interface and experience. HTML and GUI based systems should not be too hard to develop so long and the actual information that needs to transit from one place to the other is known to be constrained by speed/bandwidth capacity. That is really not an issue. Look at what they are doing with Meshtastic. THEY have solved the issue of the user interface to attract people. They have slower speeds to offer than the current 1200 baud packet systems.

We need to learn from the Meshtasic project, "Packet Radio has a lack of a good interface and end user experience".

Flame suit on, but I ask that you think about these points before we all jump to defend how we have been doing things forever.

Sean Haga KD4WLE replied to N2KGC:

> You mean something like AREDN?
>
> - Mostly GUI driven with a familiar web interface.
> - Either RF based or Internet Tunnels to fill in gaps
> - Fast
> - Large and ACTIVE userbase
> - Active developer community
> - My entire BPQ stack is on AREDN, along with the graphical BBS interface.
> - My DX Cluster is on AREDN
> - Email, just like the internet
> - Webservers
> - Cool IM Platforms (I run RocketChat with an AREDN and regular Internet interface, so you can install the app on your smart phone)
> - VoIP
> - Computer Aided Dispatch for EmComm people
> - WinGate gateways
> - I even stuck one of my Meshtastic nodes on AREDN
> - And so on..
>
> We have almost completed an Arden Network in East Florida that stretches the entire length of Brevard county.

Brian Webster N2KGC is the current President of EastNet, a large heterogeneous Amateur Radio Packet Radio network in the Northeast US that encompasses a range of legacy Amateur Radio networking systems.

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We Need Better, More Flexible User Interfaces

By Steve Stroh N8GNJ

*Editor's postscript to **Why It's So Hard to Get People Excited About Using Connected Packet Systems** (previous article) by Brian Webster N2KGC, and comments by Sean Haga KD4WLE.*

N2KGC's article nicely illustrates that even existing, working, active Amateur Radio Packet Radio are struggling to evolve in this era. N2KGC is correct that the varied… and antiquated… and sparsely / poorly documented user interface(s) to the EastNet network elements *is a stumbling block to new Amateur Radio Operators* (with no previous background on legacy Packet Radio), but slowly we're getting a handle on that. We're no longer resource constrained to host new user interfaces - we have ample compute power and we have powerful user interface and scripting tools including interactive web apps. My two primary examples of *how much better user interfaces for Amateur Radio data networks can be* are two stellar, modern apps - RadioMail for Apple iPhone / iPad (primarily for Winlink) and VarAC for Windows (primarily for use with VARA HF and VARA FM).

We don't have to start entirely from scratch. We have some great, friendly, graphical user interface (GUI) applications like WINTNC (venerable enough to include support for Baycom modems), D-RATS (originally developed for Icom D-Star radios for the ~900 bps data stream built into every D-Star radio), and in N2IRZ's article he mentions TARPN Home.

DigiPi is a great example of a friendlier user interface (all the apps run in a web browser on a remote device like laptop, tablet, or phone)… but there needs to be a more fundamental rethinking of the separation of the networking and the user interface. N2KGC's mention of Meshtastic is a good example of a nice user interface, but that's an entirely fresh start with no backwards

compatibility.

Modern email on Amateur Radio via KA9Q NOS

“Back in my day…” (yeah, dating myself…) one of the best examples of a nice user interface was the example of KA9Q NOS (stay with me… yes, *really*, KA9Q NOS). NOS was essentially a TCP/IP stack that ran on DOS, but had built-in drivers for Amateur Radio Packet Radio hardware, including KISS TNCs. One of the best ideas of KA9Q NOS was that it had standard interfaces that sent and received email. You *could* compose and read email using the very geeky “Bdale’s Mailer” companion app… but KA9Q NOS also supported a standard POP and SMTP interfaces… so you could use an email app like Eudora or Thunderbird - all you had to do to use a modern mail client with Amateur Radio networking was to point the mail app to the appropriate ports on your Amateur Radio system (which is the same approach that RadioMail and VarAC use). This capability is still present in modern “xNOS” applications - G8BPQ, JNOS, etc.

Amateur Radio has significant *new* technologies such as MMDVM-TNC that may allow us up to 38.4 kbps over conventional 20 kHz VHF / UHF channels (perhaps even via repeaters), we have New Packet Radio which may allow up to 1 Mbps on 1 MHz VHF / UHF channels, and as KD4WLE pointed out, we now have fast (microwave network) data capability with AREDN (and HamWAN, and HAMNET.EU). None of this has to be either / or, or requires completely jettisoning the old stuff in favor of something entirely new (such as Meshtastic). It does require some rethinking of old paradigms such as N2KGC points out, and some adaptation to make the networking available in one area (such as EastNet) look like “just another network” in a unified, easy to comprehend and operate user interface based on modern user interface frameworks and modern networking. Sending an email via Packet Radio BBS to Amateur Radio Operator “A” should be just as easy as sending an email via AREDN to Amateur Radio Operator “B”, and there should be a standard way to view the contents of a Bulletin Board System without resorting to a dumb terminal interface where every prompt is sent every time.

We (Amateur Radio) really *can* have it both ways - legacy networks and new, more capable networks - we just have to have some help making better user interfaces and adhering to the “stack layers” (which has gotten kind of muddled in Amateur Radio these last few decades).

Lastly… if you… or you and some co-consiprators, have the skills and the desire to tackle such an ambitious project as developing a well-structured user interface for Amateur Radio networking, with support for many / most / all of the wild and wooly Amateur Radio networks that have been developed over the decades…

There is funding available to put serious, sustained effort into such a project. If you’re an individual contributor(s) that are not directly eligible for an ARDC grant, see how the FreeDV team was able to get an ARDC grant via a fiscal sponsor.

Steve Stroh N8GNJ is the Editor of the Zero Retries newsletter and an outspoken advocate of data communications using radio technologies in Amateur Radio.

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ZR > BEACON

By Steve Stroh N8GNJ

Short mentions of Zero Retries Interesting items.

AMSAT / TAPR Banquet at Hamvention 2024 - PACSAT!

ANS-084 AMSAT News Service Weekly Bulletins - March 24, 2024 by Frank Karnauskas:

> Another attraction will be the 15th annual AMSAT/TAPR Banquet on Friday at 18:30 EDT. This dinner is always a highlight of the TAPR (Tucson Amateur Packet Radio) and AMSAT (Radio Amateur Satellite Corp.) activities during the Dayton Hamvention. This year’s banquet speaker will be Bill Reed, NX5R, AMSAT Volunteer Engineer, who will highlight the forthcoming PACSAT digital communications payload.

Of all the current, and proposed AMSAT satellites / payloads, PACSAT is the most Zero Retries Interesting… and AMSAT has revealed… *not much*… to date about PACSAT. I’m sure that NX5R’s banquet speech will be especially interesting and revealing as all the other AMSAT activities have to compete on AMSAT’s packed forum schedule during Hamvention. I don’t always attend the AMSAT / TAPR Banquet when I attend Hamvention… but *this* one I would definitely make time for. Wish I was able to attend Hamvention 2024!

RadioMail :: Portable VARA FM HotSpot

This video is ~ 3 months old, but it's new to me (I learned about it from the RadioMail newsletter - scroll to the bottom of the RadioMail page to subscribe). Georges Auberger WH6AZ shows how to use Winlink to send Internet email from a very compact VHF / UHF station consisting of a Windows PC (palm sized, battery powered…) to run VARA FM, a Digirig Mobile audio interface connected to a portable radio, and WH6AZ's application RadioMail which connects to the PC via Wi-Fi. I was impressed that the Windows PC running VARA FM had been reduced to a physically small *appliance* (no screen, keyboard, or pointer)… just apply power and input / output cables. WH6AZ provides a polished demo of a streamlined and portable system - a "Go Kit" in a pouch.

ARRL Seeking Applicants for Assistant Education and Learning Manager

The ARRL Letter for April 4, 2024:

> ARRL is working to engage the next generation of radio amateurs right in the classroom. Many young people have become active hams because of the ARRL Teachers Institute on Wireless Technology.
>
> This donor-funded effort brings teachers from across the United States together to get them excited about radio through hands-on experiments. The Institute then trains them on how to take that excitement back to their classrooms as they incorporate amateur radio into science, technology, engineering, and mathematics (STEM) learning.
>
> Now, we're looking for the right candidate for a position that will help us grow that program. In a posting at www.arrl.org/employment-opportunities, potential candidates can find the entire list of criteria we're looking for in the Assistant Education and Learning Manager.
>
> The position is perfect for someone with an education background, but the most important trait is being able to authentically share a passion for amateur radio, according to ARRL Education and Learning Manager Steve Goodgame, K5ATA. "We want someone energetic and passionate about amateur radio - willing to hit the streets at conferences to get teachers fired up. This person is going to help run the Teachers Institute and be a champion for engaging youth in amateur radio," he said.
>
> Someone who has a passion for educating will be a great fit. According to the listing, the incumbent will develop schedules, choose material and coursework, and understand the needs of education program students. The Assistant Manager will work to facilitate and instruct Teachers Institute sessions.
>
> If you're interested in the job, email Goodgame at sgoodgame@arrl.org. ARRL is an equal-opportunity employer.

The ARRL Teachers Institute on Wireless Technology…

> … is a donor-funded professional development program designed to help classroom teachers elevate their STEM programs through the use of wireless technology. As a part of the ARRL Education & Technology Program, several sessions are conducted each year, and the program continues to grow.Teachers Institute is filled with lectures, hands-on activities, and demonstrations to inspire teachers so they can inspire their students through the use of tools and strategies to introduce basic electronics, radio science, satellite communications, Amateur Radio, radio direction finding (fox hunting), weather science, microcontrollers, and electronic sensors to their students. Teachers are provided with the equipment needed to take wireless technology to their classrooms. If you, or someone you know, would like to support ARRL's mission to elevate STEM programs in schools, click here: DONATE TODAY or contact the ARRL Development Office at (860)594-0291

I understand that "data communications via radio" is a tough concept to teach when *radio* is a pretty new concept to most teachers. But I do wish ARRL would *try* to demonstrate that "radio" is capable of modern communications like data and text messaging. One method to do so, since there will undoubtedly be portable radios involved, would be to demonstrate the Ribbit / Rattlegram text messaging app which runs on Android or iPhone and *acoustically couples the audio* (no cables or hardware audio interface required) into any portable radio using the *radio's* speaker / microphone to send and receive data using the *phone's* speaker and microphone. Perhaps whoever fills this new position at ARRL will be able to incorporate Ribbit / Rattlegram into the curriculum of the Teacher's Institute for Wireless Technology.

PyHam Paracon

Martin Cooper KD6YAM:

> Paracon is a packet radio terminal for Linux, Mac and Windows. It is focused on simplicity and ease of use, and incorporates the core functionality that most packet users need without trying to include all of the bells and whistles

that few would use.

Key features of Paracon include:

- Multiple simultaneous AX.25 connected mode sessions, allowing for connections to multiple BBS or other remote nodes.
- Unproto (UI, or datagram) AX.25 mode, allowing for keyboard-to-keyboard chat or other non-connected uses.
- Text-based console application looks and behaves the same on all supported platforms (Linux, Mac, Windows).
- Uses the AGWPE protocol to communicate with any server implementing that protocol. Tested and supported with Direwolf, ldsped and AGWPE.
- Self-contained executable requires only a Python installation to run, without the need to install any additional dependencies.

As interesting as Paracon is, I actually became more interested in the parent (?) project of Paracon, PyHam:

> PyHam is a collection of applications and software libraries for ham radio enthusiasts, written in Python.
>
> The applications are intended to address real-world use cases for the ham while keeping complexity to a minimum and focusing on ease of use. By avoiding the lure of trying to be all things to all people, PyHam applications target the majority of users at the possible expense of those few who may desire additional capabilities.
>
> The libraries are written in pure Python, and each focus on a particular technology with the goal of making that technology easier to work with than it otherwise would be. PyHam applications are themselves built upon these libraries.
>
> PyHam software has been developed with a primary focus on Direwolf as a platform, since it is the dominant software TNC in use today. However, where appropriate, the software has also been tested against other platforms such as ldsped and AGWPE.

PyHam applications include:

- **Paracon** (described above)
- **Libraries** - Python packages that can be installed from PyPI, the Python Package Index, using pip.
- **PyHam_AX25** - Modules for working with AX.25 packets in an amateur packet radio environment on all platforms. Includes support for NET/ROM routing table updates, and also facilities for working with the Linux native AX.25 stack.
- **PyHam_KISS** - A client implementation of the KISS TNC protocol, providing send and receive capability via a TCP/IP connection.
- **PyHam_PE** - A full Packet Engine client library for the AGWPE protocol, enabling and simplifying the creation of connected-mode and unconnected applications that communicate through servers such as Direwolf or ldsped.

These would seem to be ideal “building blocks” for future Amateur Radio data communications modes. From my limited understanding, these modules offer a “template” for how to create “modules” when implementing other or new data modes used in Amateur Radio using a modern software framework.

My thanks to Chris Lance WW2BSA for mentioning this interesting development on the EastNetPacket mailing list.

Using AREDN Cross Links

Tim Wilkinson KN6PLV:

> A cross-link allows you to pass AREDN traffic across non-AREDN network links.
>
> **Comparison with tunnels**
>
> Tunnels and cross-links both connect two nodes together, so they are the same in that respect. However, they do it in very different ways.

Tunnels are a simple to use, all in one feature, which operates over your regular Internet to connect two AREDN nodes. There is a bit of configuration information to exchange, but it is all fairly easy to set up. Tunnels only work over your WAN connection, you use the IP address given by the server, and there is very little else to configure.

Cross-links, on the other hand, are much more basic and flexible. The configuration lets you choose IP addresses yourself, as well as setting a VLAN and port on which xlink traffic leaves the device. The IP addresses let the system route the data (OLSR works at layer 3 so every interface needs an IP address), but unlike the tunnel you can set these addresses any way you desire. You choose any unused VLAN number yourself, and the port sets how you want the data to be physically sent into or out of the node. How the data is moved to the peer device is not defined in any way, and deliberately so. Maybe you want to connect that port directly to a non-AREDN PtP radio. Maybe you feed it into a switch then use some other tunneling technology to get it where it needs to go. Maybe it is just a bit of Ethernet cable. It is entirely up to you. Personally, I use tunnels to connect nodes over the Internet, but I use xlinks to connect nodes over Point-to-Point radios which are not running AREDN firmware.

I knew that this was a capability of AREDN, and widely used in larger AREDN networks… I just didn't know the particulars or the terminology, and KN6PLV explains it well in this article.

Apologies that I didn't record who in the Mid-Island AREDN group (Vancouver Island, British Columbia, Canada) brought this to my attention.

WSPR to the Wind With a Pi Pico High Altitude Balloon

Richard Baguley in Hackaday:

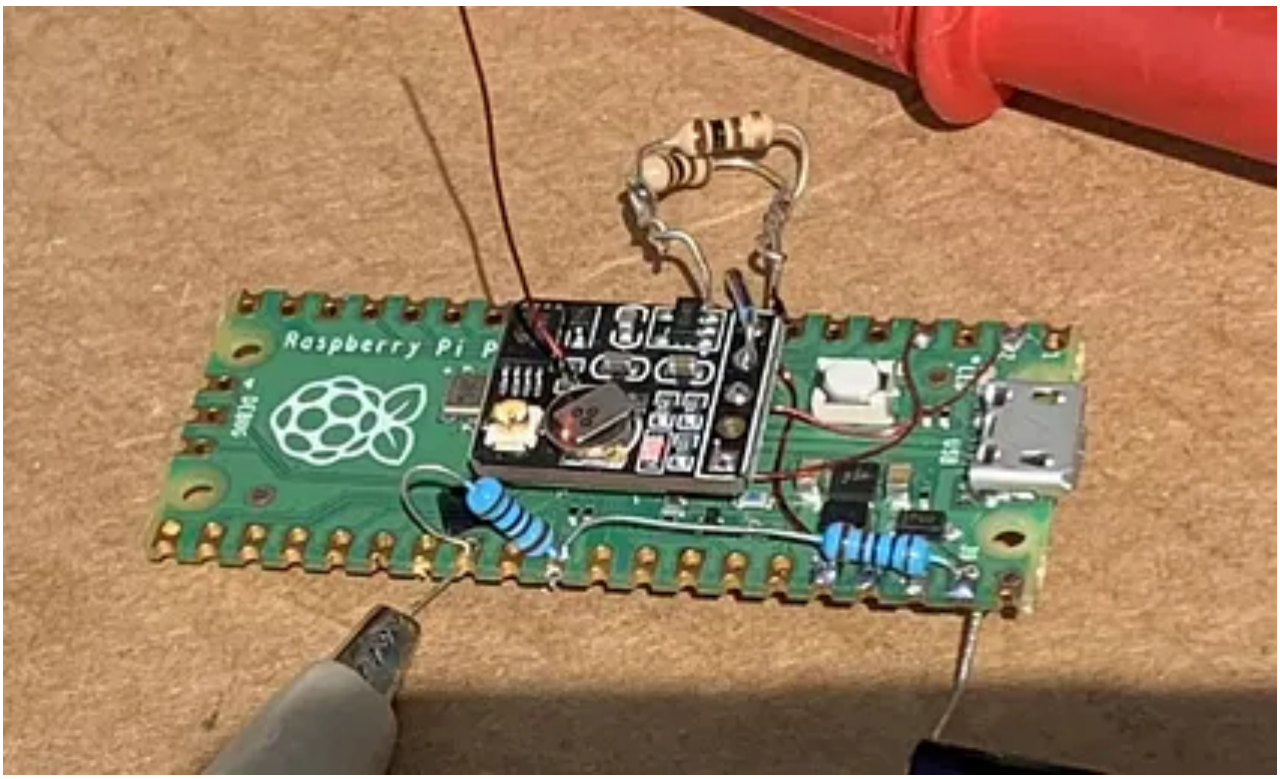

Image courtesy of Hackaday

They say that if you love something, you should set it free. That doesn't mean that you should spend any more on it than you have to though, which is why [EngineerGuy314] put together this Raspberry Pi Pico high-altitude balloon tracker that should only set you back about $12 to build.

This simplified package turns a Pico into a tracking beacon — connect a cheap GPS module and solar panel, and the system will transmit the GPS location, system temperature, and other telemetry on the 20-meter band using the Weak Signal Propagation Reporter (WSPR) protocol. Do it right, and you can track your balloon as it goes around the world.

The project is based in part on the work of [Roman Piksayin] in his Pico-WSPR-TX package (which we covered

before), which uses the Pico's outputs to create the transmitted signal directly without needing an external radio. [EngineerGuy314] took this a step further by slowing down the Pico and doing some clever stuff to make it run a bit more reliably directly from the solar panel.

If *this* project doesn't get your imagination stirring about what's possible in Amateur Radio with incredibly powerful, but cheap computing power (again, notice… ***no… radio…****)* then please just unsubscribe now from Zero Retries.

This project epitomizes my recently updated email tagline:
Radios are Computers - With Antennas!

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Join the *Fun* on Amateur Radio

If you're not yet licensed as an Amateur Radio Operator, and would like to join the fun by *literally having a license to experiment with radio technology*, check out
Join the Fun on Amateur Radio for some pointers.

Zero Retries Frequently Asked Questions (FAQs) — In development 2023-02.

Closing the Channel

In its mission to highlight technological innovation in Amateur Radio, promote Amateur Radio to techies as a literal license to experiment with radio technology, and make Amateur Radio more relevant to society in the 2020s and beyond, Zero Retries is published via email and web, and is available to everyone at no cost. Zero Retries is proud *not to participate* in the Amateur Radio Publishing Industrial Complex, which hides Amateur Radio content behind paywalls.

My ongoing ***Thanks*** to:

- Tina Stroh KD7WSF for, well, *everything!*
- ***Founding Members*** **who generously support Zero Retries financially:**
  Founding Member 0000 - Steven Davidson K3FZT
  Founding Member 0001 - Prefers to Remain Anonymous 01

  Founding Member 0002 - Chris Osburn KD7DVD
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  Founding Member 0004 - William Arcand W1WRA
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- Numerous Annual and Monthly subscribers who also generously support Zero Retries financially!

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- The *most* effective way to support Zero Retries is to simply mention Zero Retries to your co-conspirators that are also interested in knowing more about technological innovation that is occurring in Amateur Radio and encourage them to become a fellow subscriber.
- One particularly effective method of promoting Zero Retries is to add a mention of Zero Retries to your QRZ page (or other web presence) and include a link:

  https://www.zeroretries.org
- If you'd like to financially support Zero Retries, becoming a paid subscriber is *greatly* appreciated and helps offset expenses incurred in publishing Zero Retries. Paid subscriptions for Zero Retries are *entirely optional*, as explained in this special issue of ZR:
  Zero Retries Administrivia - Activating Payment Options.

These blogs and newsletters regularly feature Zero Retries Interesting content:

- Dan Romanchik KB6NU mentions "Zero Retries Interesting" topics so regularly on his blog (that I otherwise wouldn't know about) that I've bestowed on him the honorific of Pseudostaffer.
- Jeff Davis KE9V also mentions "Zero Retries Interesting" topics so regularly on his blog (that I otherwise wouldn't know about) that I've bestowed on him the honorific of Pseudostaffer.
- Amateur Radio Weekly by Cale Mooth K4HCK is a weekly anthology of links to interesting Amateur Radio stories.
- Experimental Radio News by Bennet Z. Kobb AK4AV discusses (in detail) Experimental (Part 5) licenses issued by the US FCC. It's a *must-read-now* for me!
- RTL-SDR Blog - *Excellent* coverage of Software Defined Radio units.
- TAPR Packet Status Register has been published continuously since 1982.
- Other Substack Amateur Radio newsletters recommended by Zero Retries.

These YouTube channels regularly feature Zero Retries Interesting content:

- HB9BLA Wireless by Andreas Spiess HB9BLA
- KM6LYW Radio by Craig Lamparter KM6LYW (home of the DigiPi project)
- Modern Ham by Billy Penley KN4MKB
- Tech Minds by Matthew Miller M0DQW

Zero Retries is currently using the Substack email publishing platform to publish Zero Retries. It's particularly suitable for small newsletters as you can get started for no cost.

If you're reading this issue on the web and you'd like to see Zero Retries in your email Inbox every Friday afternoon, just click below to join ***1500+*** other subscribers:

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Zero Retries (N8GNJ) is on Mastodon — n8gnj@mastodon.radio — just click:

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Zero Retries (N8GNJ) is also on Bluesky — @n8gnj — just click:

Zero Retries / N8GNJ on Bluesky

Email issues of Zero Retries are "instrumented" by Substack to gather basic statistics about opens, clicking links, etc.

More bits from Steve Stroh N8GNJ:

- SuperPacket blog — *Discussing new generations of Amateur Radio Data Communications — beyond Packet Radio (a precursor to Zero Retries)*
- N8GNJ blog — *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs — Bellingham, Washington, USA*

Thanks for reading!

Steve Stroh N8GNJ / WRPS598 (He / Him / His)
These bits were handcrafted (by a mere human, not an Artificial Intelligence bot) in beautiful Bellingham (The City of Subdued Excitement), Washington, USA, and linked to the Internet via **Starlink *Satellite* Internet Access**.

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Editor's Note - G8BPQ Nodes can use a variety of networking options, including "Net/ROM / TheNET" mesh networking as well as conventional connections supported directly in AX.25.